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Canadian Patents Database

(12) **Patent:** (11) **CA 868197**

(54) APPARATUS FOR HANDLING MULTIPLE CONTINUOUS CASTINGS

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ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

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This invention relates to a transfer apparatus for simultaneously handling multiple continuous castings as the individual castings exit from an overall common casting station. More particularly, it is concerned with providing an improved apparatus for withdrawing a plurality of progressively advancing lengths of continuously cast metal ingots, bars and the like from a common horizontal casting station and for thereafter directing said ingots, bars, etc. to another metal treating station, such as a sawing station, where the continuously cast lengths of metal are cut into selected segments or sections.

It is particularly important in the simultaneous handling of continuously cast metal ingots, bars, billets or rods, such as those made of aluminium or an aluminium alloy at a horizontally arranged casting station to be able to move or propel all of the continuously cast metal ingots, etc. that emerge from this common, continuous casting station continuously away from the casting station at substantially the same rate and in the same general direction toward a further treatment station irrespective of slight differences in the transverse cross-sections from one ingot, etc. to another and irrespective of variations in the cross-sectional dimensions between the initial portion of a given casting as it initially emerges from a mold and the remaining portions thereof. The apparatus must also draw the ingots, bars, billets or rod from the casting station at a relatively slow rate so that ample time will be given for molten aluminium in the individual casting molds to be properly transformed into a solid skin or shell defining the surface of the ingot, billet, bar or rod. Final solidification of the castings

takes place or can be completed outside of the molds by the selected direct quench of the bars by the usual coolant spraying.

All of the above procedures are merely indicative of and further emphasize the close, precise and proper control that must be exercised in moving the emerging and continuously cast ingots by the apparatus of the instant invention from the casting station to another station. Accordingly, it is a primary purpose of the instant invention to provide an improved apparatus for withdrawing a plurality of individually and continuously cast lengths of ingots, billets, rods or bars, etc. in a substantially uninterrupted, smooth and reliable fashion from an overall common casting zone or station at one and the same time and for thereafter transferring all of the said continuously cast elements toward a further treatment zone, such as a sawing zone, where the continuously cast elements are then cut into selected lengths for further handling or treatment.

The instant apparatus operates firstly to withdraw the continuously cast articles simultaneously from a common casting station in such fashion as to assist and not interfere with the normal individual casting operations; and secondly, to present the cast elements to a sawing device in such fashion that it assists the saw in cutting the cast elements to lengths while at the same time preventing the saw from disturbing the casting operations. In short, the instant device makes it feasible to provide a relatively simple sawing operation close to a horizontal continuous casting operation or station.

These and other purposes of the instant invention will become more apparent from a review of the following

detailed description when taken in conjunction with the accompanying drawings which illustrate various embodiments of the invention.

Figure 1 is an overall broken perspective view of the apparatus of the instant invention and illustrates its disposition intermediate a common, horizontal, continuous metal casting station and a traversing saw device for cutting the continuously cast ingots, rods, bars, slabs, etc. into selected lengths.

Figure 2 is a broken elevational, cross-sectional view of a modified type transfer device that can be used in practicing the instant invention.

Figure 3 is a broken cross-sectional view of the apparatus shown in Figure 1, when taken generally along lines 3-3 thereof and with parts added and with other parts removed; and

Figure 4 is a schematic view of a suitable type of fluid control circuit that can be used in operating the various roller elements of the transfer device of Figure 1 of the instant invention.

With further reference to the drawings and, in particular, Figure 1, the novel metal handling and transfer device 8 of the instant invention is selectively disposed intermediate a common horizontal casting station C and a sawing station S. For the sake of brevity, the instant device will be described with reference to the continuous casting and handling of multiple aluminium and aluminium alloy ingots. The term "ingot" as used in the instant specification and claims is intended to cover and embrace continuously cast rod, bar, slab, billet and the like from all ferrous and non-ferrous metals including aluminium and aluminium alloys that can satisfactorily continuously cast

into ingots.

The casting station C is provided with the usual series of casting molds 10, each of which can be of the water cooled type generally disclosed in U.S. Patent 2,996,771 issued August 22, 1961, for effecting proper solidification of the continuously cast ingots. Although the continuous casting operation per se and the molds therefor do not constitute a significant part of this invention and no detailed discussion of the same will be given, it should be noted that the transfer apparatus 8 should be so located relative to the molds 10, of which three are shown in the drawings for the purposes of illustration, whereby the emerging and continuously cast ingots will be sufficiently solidified by the time the various portions thereof are contacted by the rolls of device 8. Thus, the rolls of transfer device 8 can contact and grip the cast products without adversely affecting the physical structure or surface quality characteristics of the cast metal elements.

In addition to the solidification problem aforementioned, various other problems are involved in the instant operation. For example, the continuously cast ingots must be held firmly between a series of rolls or like elements during the time the cast material is being sawed, but without at the same time adversely affecting or interfering with the casting operation. The roll elements of the transfer device 8 in effect serve as combination metal holding and dampening elements by holding the metal ingots for sawing while at the same time dampening the shocks, cutting vibrations or chatterings introduced into the ingots during the sawing. In other words, the device 8 prevents the shocks, etc. from being transmitted into the

casting operation where they could deleteriously affect either the movement of the ingots from the molds, or the ultimate solidification of the ingots so that sound ingots are not produced.

A further problem in the instant type casting operation relates to differentially cast sections of the ingots. In the event, for example, that the sections of each of the various ingots 14 of Figure 1 simultaneously located along the roll ingot contact or roll pass line B-B do not all have the same exact height or thickness whereby some ingots 14 have high spots and another ingot 14 simultaneously has a low spot along such line, a single driven top roll of the roll assembly close to the sawing station S could not properly engage the ingot with the low spot and exert the requisite rolling pressure to move the low spot ingot away from the casting station. There are also instances where individual ingots may have high spots which would act to keep a common top roll out of contact with the low spot ingots. In short, a single set of two rolls is not satisfactory for both holding the ingots 14 for sawing and for moving the ingots away from the casting station. Additional rolls arranged in a unique fashion are required as will now be described.

Accordingly, in a preferred embodiment of the invention, this second set of rolls comprises individual pinch roll devices that separately and individually contact given ingots. Each of these rolls is separately actuated so as to bear upon its associated metal ingot and bring such ingot into contact with a common driving and support roll whereby irrespective of what transpires at the exit end of the apparatus 8 all of the ingots 14 emerging from casting station C will be continuously passed toward the

sawing zone S.

The use of a second set of rolls allows the first set of rolls disposed adjacent to the sawing zone to still perform their advantageous function of acting as a barrier against the transmission of sawing shocks, vibrations or chattering from the shearing or sawing device into the continuous casting zone or station C.

Accordingly, in a preferred embodiment of the invention and as indicated in Figure 1, the transfer apparatus 8 located between the casting station C and the sawing station S is generally comprised of a first set of rolls 12 mounted adjacent sawing station S by way of a simplified mill housing stand or assembly 13 made up of welded elements and disposed on a floor mounted base frame 11. Roll set 12 preferably includes single upper and lower driven rolls 16 and 17. The shafts 26 to which rolls 16 and 17 are keyed are mounted in appropriate bearing members or chock blocks 18 and 19. These blocks are slidably disposed in the windows 20 of the mill stand 13 in a conventional fashion. For example, a chock block, such as a chock block 18, can be made up of two parts 21 and 21' locked together by bolts 17' after inner part 21 provided with a grooved portion 19' that fits within a window 20 of the roll stand is first installed in the window.

It is desirable that one of the rolls, such as top roll 16, be adjustably mounted relative to the roll 17 and with appropriate means (not shown) being used to anchor the lower chock blocks 19 for roll 17 rigidly in place. This adjustability of upper roll 16 is effected by means of hydraulic actuating cylinders 30 and 32. The pistons 30' in cylinders 30 and 32 are pivotally connected to the

chock blocks 18 for the upper roll 16 by means of the piston rods 34. One of the rolls of roll set 12, such as upper roll 16, is preferably covered by a suitable grade of compressible rubber or rubber-like material 34' that can be sprayed onto or wrapped about and vulcanized to the roll.

The purpose of rubber covering 34' is primarily to maintain the proper roll grip on the work by compensating for the very small differences in actual ingot size caused by machining tolerances of approximately $\pm$ 0.002" on the mold cavities as well as wear on individual mold sections.

The instant transfer device 8 is provided with a further and unique set of rolls 40. Second roll set 40 preferably includes a common lower supporting and driving roll 42 for all of the cast ingots 14. Roll 42 can be knurled, serrated or sandblasted to enhance its frictional ingot engaging characteristics. The opposing ends of shaft 43 to which roll 42 is keyed are supported in the usual fashion in journals 44 affixed to base frame 11.

The shafts 26 and 43 of rolls 16, 17 and 42 are driven in a conventional manner and at the same speed by the normal polyphase variable speed drive motors 24, all operated by a common generator means 25. As indicated particularly in Figures 1 and 3, disposed above and in general vertical alignment with lower roll 42 is a series of pinch roll assemblies 48. Each pinch roll assembly 48 includes a forked roller support 50. A grooved idler and pinch roller 52 is freely journaled between the fork elements 54 of support 50 by means of shaft 56. Roller 52 is grooved so that it can be used for cross-sectionally round ingots 14' as well as cross-sectionally square or rectangular ingots 14. In one advantageous embodiment of the invention, the various roll assemblies 48 can be carried

by an upstanding inverted U-shaped frame 60, the legs of which are affixed to the base frame 11. One or more upper cross bars 62 of this frame carries and supports a series of cylinders 64, one for each roller assembly 48, and there is one roller assembly 48 for each pouring port 10 in common casting station C. Pistons 65 are disposed in cylinders 64 and upper ends of piston rods 66 are connected to the pistons 65 while the lower end of each piston rod 66 is connected to a forked roller support 50. Track or guide elements 67 attached to cross-bars 62 fit into grooves in the roller supports 50 and can be used to keep the roller supports 50 in the proper vertical planes during movements of the same. From the above, it will be apparent that when a given piston 65 is actuated in a downward direction it forces the roller 52 controlled by the piston downward and against one of the moving ingot sections 14 whereby this ingot section will be forced into engagement with lower driving roller 42 and moved forward constantly at all times irrespective of whatever driving action with respect to this same ingot section may or may not occur in the other roll set 12 made up of rolls 16 and 17 and regardless of what kind of movement is being given to an adjacent ingot 14 at the same time.

Figure 4 illustrates one suitable type of fluid circuit that can be used for operating the first and second set of roll devices 12 and 40 of the instant invention. The circuit can comprise the usual pump device 70 driven by motor M and located in the common conduit 72 which operates to pass fluid into line 72 at the proper preselected line pressure, e.g. 600 psi. Connected to line 72 is a branch line 74 which can contain a pressure relief valve 76 whereby when the

pressure in line 72 becomes excessive, fluid from the pump P can be dumped back into the reservoir R by way of line 74 directly from the pump 70.

Line 72 is connected to a four-way valve 78 that can be manually operated by way of line 73. Line 73 contains a pressure relief valve 74'. When the valve 78 is in the usual or primary operating position, ports X and Y are connected at the same time ports W and Z are connected. With the ports of the valve 78 so connected, fluid from line 72 passes through line 73 into and out of valve 78 and into line 80 and thence into branch lines 82 and 84 which lead to cylinders 30 and 32. This will cause pistons 30' and piston rods 34 connected to the chock blocks 18 of the upper roll 16 to move downwardly.

At the same time fluid is passed through lines 80, 82 and 84 to the top side of the cylinders 30 and 32, fluid is evacuated from the bottom sides of cylinders 30 and 32 by way of line 86 leading to port Z of valve 78 and then out port W through lines 88 and 106' and back into reservoir R. At the same time pump 70 supplies fluid to the circuit to force the top roller 16 down into bearing engagement with the various ingot sections being continuously cast and fed to roll set 12 and the sawing station S, pump 70 also operates to pass fluid from line 72 through the extension 72a thereof and into the four-way valves 90 controlling the operations of pinch roll assemblies 48. Preferably a separate valve 90 is used for each assembly and since they all are similar in structure and function, a description of one will suffice for all.

When valve 90, which can likewise be hand operated, is manipulated by the operator to the primary operating position, ports D and E thereof will be

connected at the same time ports F and G are connected. When valve 90 is in this condition, fluid will pass through the common manifold line or extension conduit 72a into branch line 92 and then through ports D and E of this valve. From valve 90, fluid then passes into line 94 and to the top of a cylinder 64 whereby pressure can then be exerted upon a piston 65 in a cylinder assembly so as to force the same down along with the roller 52 connected thereto. Line 72a advantageously contains a pressure reducing valve 75 whereby the pressure in a line 92 can be substantially reduced over that in line 72a, e.g. from 600 psi to 300 psi since the pressure required to move each of rollers 52 against a given ingot is usually less than that required to move roller 16 down against all the ingots 14.

The pressure which these rollers 52 then bring to bear upon their associated ingot elements 14 will force these elements 14 into firm contact with the common driving roller 42, whereby each ingot 14 can be positively driven towards the first set of rolls 12 and zone S independently of every other ingot 14 being cast. As the proper holding pressure is reached in each cylinder 64, it will be maintained. At the same time that hydraulic pressure fluid is passed to the top side of a cylinder 64, fluid from the bottom side of the same cylinder is forced out through the bottom line 100 into port F of a valve 90 and then out through the port G of the valve through exhaust lines 106 and 106' which lead to the reservoir R. If desired, a one-way ball check valve 108 may be placed in line 88 for valve 78 while a ball check valve 110 can be placed in each line 106 for a valve 90. By virtue of the aforesaid arrangement, each roller 52 can be separately

operated and remain in a predetermined pressure contact with its associated ingot 14 irrespective of variations in the height of the ingot in contact therewith and irrespective of what driving action is produced by roll set 12 on the same or other ingots.

At the end of the casting operation, valves 90 and 78 are manipulated by the operator, whereby ports D and F of valve 90 are connected at the same time ports E and G are connected while ports X and Z of valve 78 are interconnected in opposition to interconnected ports Y and W of the latter valve.

When a valve 90 is so actuated, the fluid pressure exerted upon the pistons in cylinders 64 will cause an upward movement of the pistons 65 along with the rollers 52 connected thereto. Fluid from the top side of cylinders 64 then moves back through lines 94 and ports E and G of valves 90 and then through lines 106 and 106' into reservoir R. In the case of valve 78, when the ports thereof are connected as immediately described, fluid from pump 70 will pass through ports X and Z and into the bottom of cylinders 30 and 32. This causes pistons 30' in these cylinders to move up along with top roll 16 as fluid in the topside of cylinders 30 and 32 is evacuated and returned to valve 78 by lines 80, 82 and 84 and then through ports Y and W of valve 78 and lines 88 and 106' back to the reservoir R. If desired, pressure relief valve 74' in line 73 can be replaced by a pressure regulating valve in order to set the pressure on top roll 16 at different values from the main line pressure which can be on the order of 600 psi.

A brief word is in order with respect to the flying saw device at the sawing station S disclosed in

Figures 1 and 2. This saw device can be of any appropriate design and in one advantageous embodiment of the invention can be comprised of a reciprocating carriage 113. Dependingly suspended from carriage 113 is a motor mount 114 containing an electric motor (not shown) that drives shaft 114' to which rotary saw 115 is keyed in the usual fashion. The arms 116 of carriage 113 are provided with hollow sleeves 117, one of which is interiorly threaded so as to engage a threaded shaft 118 driven by reversible motor 119 carried by one of the support sleeves 120 for carriage 113 through the customary gearing (not shown) whereby saw 114 can traverse the moving ingots 14. Means are also provided for synchronizing the movements of saw carriage 113 in the same direction as the direction of travel of ingot 14 and along with ingots 14 during the simultaneous transverse cutting or sawing operation so as to effectively cut the ingots without disturbing or interrupting their normal forward progress. This means can include, for example, a pair of sleeve elements 120 slidably mounted on the rails 121 of a fixed frame 122 in a well-known manner. Bracket elements 123 are carried by the sleeve elements 120. The ends of a pair of wires or chain elements 124 shown in dotted lines in Figure 1 are affixed to each of the brackets on each side of carriage 113. These wires are trained over pulleys or sprockets 125 mounted on the fixed frame 122 as well as a suitable winding apparatus or drum(not shown), whereby when the winding apparatus or drum is motivated, carriage 113 can be moved back and forth along rails 121 at the same time carriage 113 traverses the ingots 14 to cut the same into selected lengths.

Figure 2 shows a modified version of the transfer

device 8 of Figure 1. The principal difference between the device 8' of Figure 2 and that of Figure 1 lies in the arrangement used for raising and lowering the roll 16 associated with the roll 17 in the first set of rolls. Accordingly, all like parts will be identified with the same reference numerals as in Figure 1.

In transfer device 8', the roll 16 in lieu of being disposed within a conventional type of roll housing is mounted between a pair of arms 140, only one of which is shown. These arms are pivotally connected at their fulcrum point to the common shaft 142 journaled in a pair of standards 144 mounted adjacent the ingot runout table 146. Table 146, incidentally, can be raised and lowered by conventional jack assemblies 147 so that the top of the table will always be disposed in the same horizontal plane as the top of roll 42. The forward ends of arms 140 are interconnected by means of a box-shaped bridging member 148 and the intermediate or central section of bridging member 148 is pivotally affixed to and actuated by a piston and cylinder assebly 150, all in a manner well known in the art. It will be obvious that with slight modifications the hydraulic circuit of Figure 4 can be used with the device of Figure 2. The only substantial modification required would be for valve 78 of the circuit of Figure 4 to be connected to a single piston and cylinder assembly, e.g. assembly 150 instead of two such assemblies. When this piston and cylinder assembly is appropriately actuated the roll 16, which is also rubber coated as in the case of the roll 16 of the transfer device 8 of Figure 1, can be lowered and raised and into and out of pressure contact with the ingots 14 which exit from the continuous casting station C.

It will be obvious from the above that an improved ingot transfer device has been provided which finds advantageous use particularly in a horizontal casting type operation. The instant transfer device is also fully compatible with a multiple continuous casting operation and a sawing operation that takes place relatively close to the casting operation. Finally, it is obvious that various changes and modifications may be made therein without departing from the spirit and scope thereof as defined in the appended claims, wherein:

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A transfer device for use (a) in simultaneously withdrawing a plurality of continuously cast metal ingots as they are cast from a plurality of molds of a common continuous casting station and (b) in then directing all of said ingots to a further metal treating station comprising a first and second set of driving rolls, means for positively driving at least one roll in each of said sets of rolls, said first set of driving rolls being disposed adjacent the second metal treating station and adapted to grip the cast metal ingots therebetween, said second set of rolls being interposed between said casting station and said first set of rolls and including a plurality of individually and independently adjustable pinch rolls, each of said pinch rolls being adapted to engage a separate metal ingot and to press said ingot into full frictional contact with a further roll of said second set of rolls and means for individually and independently forcing each of said pinch rolls into contact with a given continuously advancing ingot whereby all of said cast metal ingots can be continuously and simultaneously transferred to the further metal treatment station irrespective of any slippage between the rolls of said first mentioned set of rolls and one or more of said cast metal ingots.

2. A device as set forth in claim 1 wherein said further roll of said second set of rolls is a common support and driving roll for all of said cast metal ingots.

3. A device as set forth in claim 1 including means for moving one of the rolls of said first set of driving rolls toward and away from another of said rolls in said first set of rolls.

4. A device as set forth in claim 1 wherein said further roll of the second set of rolls is a common support and driving roll for all of said cast metal ingots and including means for moving one of the rolls of said first set of rolls toward and away from another of the rolls in said first set of rolls.

5. A device as set forth in claim 1 wherein said further roll of said second set of rolls is a common support and driving roll for all of said cast metal ingots and at least one of said individually adjustable pinch rolls is grooved.

6. A device as set forth in claim 1 wherein said further metal treatment station comprises a saw device movable transversely across selected portions of said continuously cast and advancing ingots while other portions of the same ingots are successively gripped by the rolls of said first set of rolls.

7. A device as set forth in claim 1 including fluid operated circuit means for moving each of the pinch rolls in said second set of rolls independently and individually toward and away from the given ingot associated therewith.

8. A device as set forth in claim 1 wherein means are provided for driving certain of the rolls in each set of rolls at the same rate of speed.

9. A device as set forth in claim 1 wherein one of the rolls of said first set of rolls is provided with an exposed surface of compressible material.

10. A device as set forth in claim 3 including piston and cylinder means for moving said one roll of said first set of rolls toward and away from another of said rolls of said first set of rolls.

11. A device as set forth in claim 3 wherein said movable roll is a pivotally mounted roll.

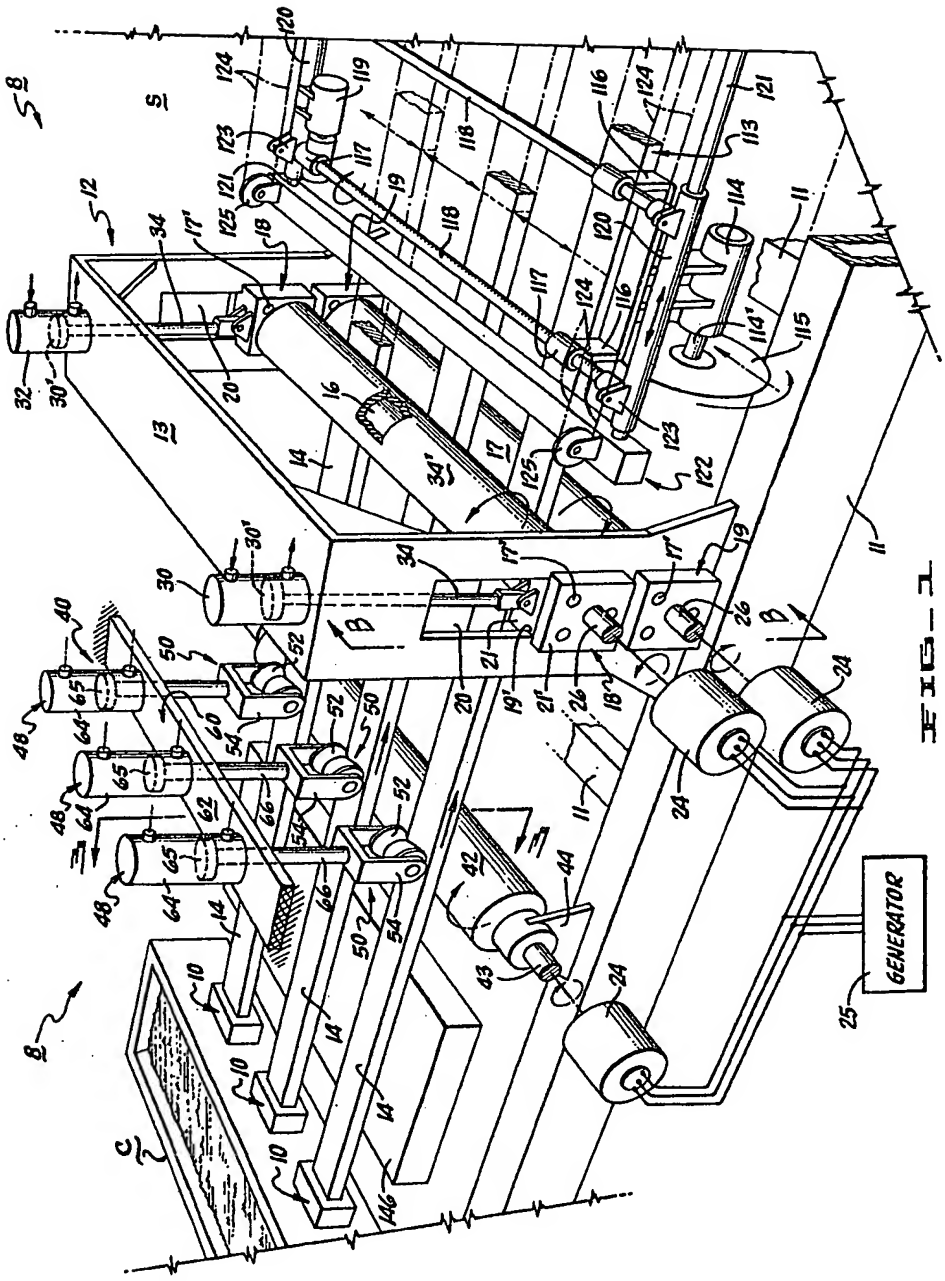

FIG. 1

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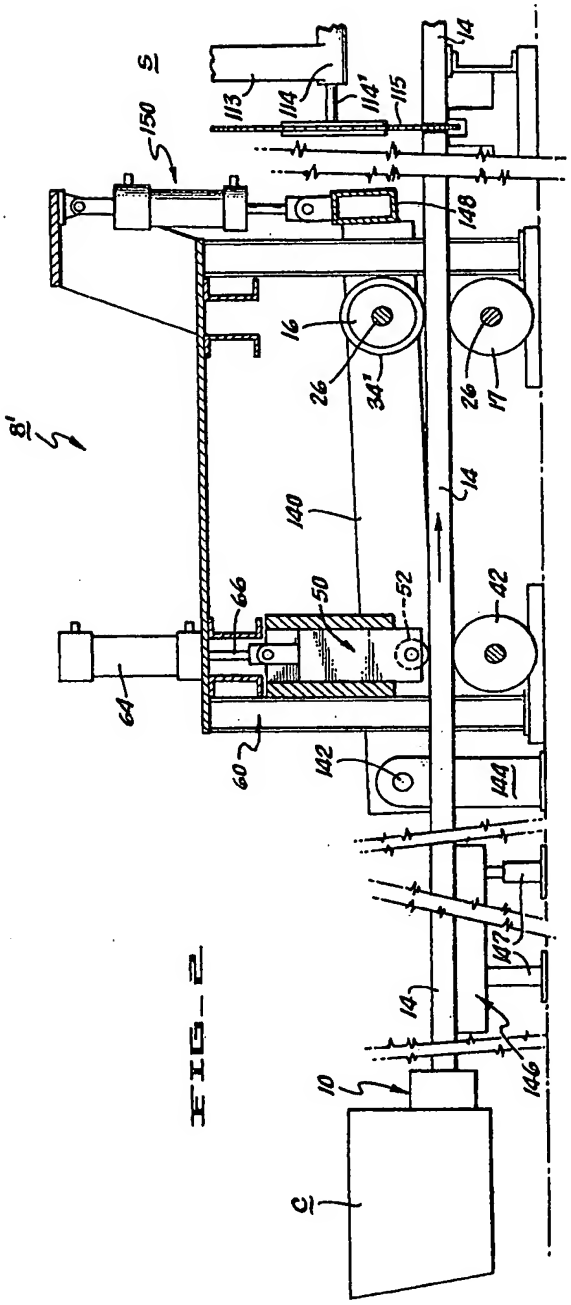

FIG-2

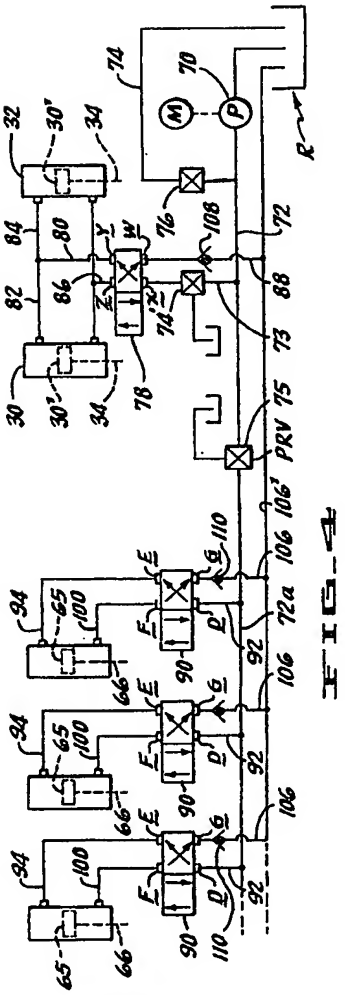

FIG-4

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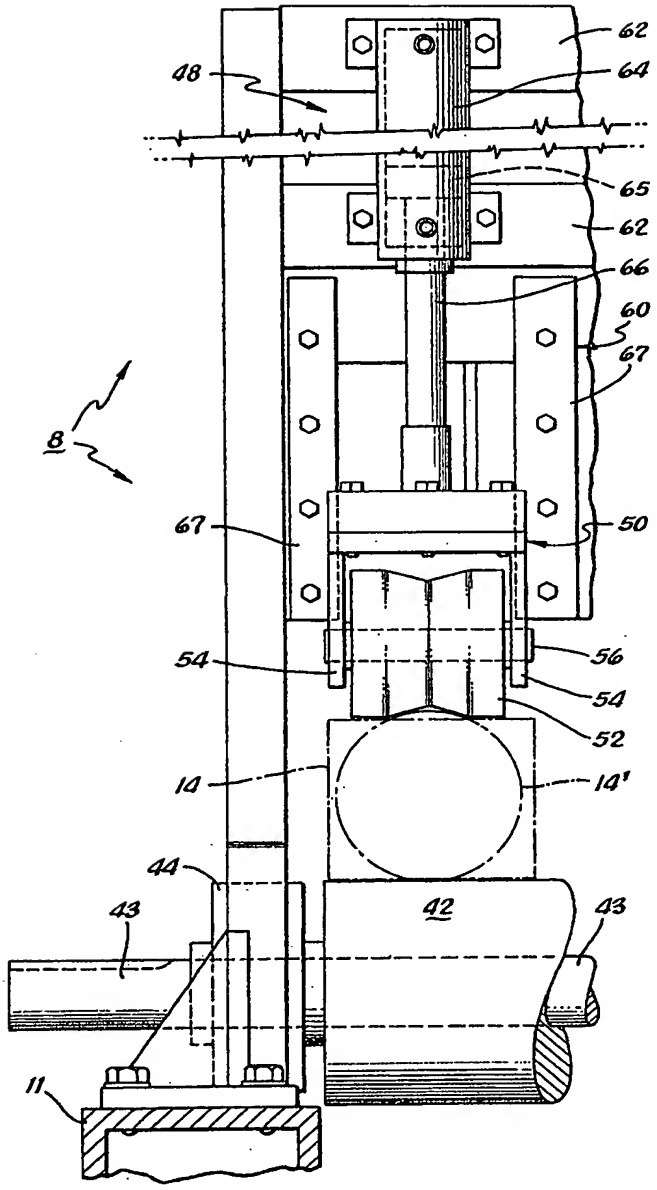

FIG. 3

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